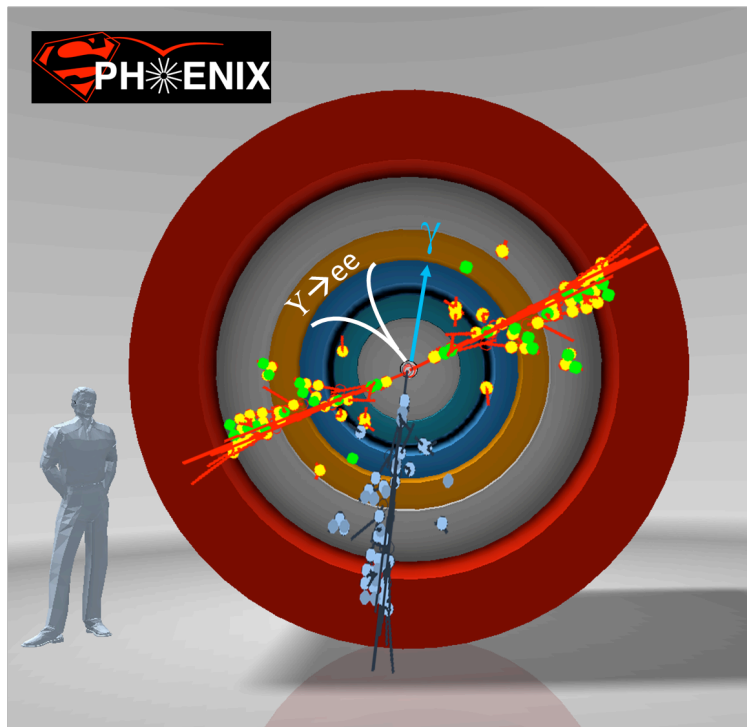# Quality Assurance Plan

sPHENIX Project
(####)

Brookhaven National Laboratory
Upton, New York

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sPHENIX Project

QUALITY ASSURANCE PLAN

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Quality Assurance Plan

Project Name: sPHENIX Project
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This version of the document may not be the current or approved revision. The current revision is maintained in the sPHENIX Project's document management system, where all internal Project document approvals are also managed.

Note: The current approved version is always available in the sPHENIX Project's document management system.

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Quality Assurance Plan Version Control

Version	Date	Author	Change Description
1.0	------	Jack Eng	Initial release

LIST OF ACRONYMS AND ABBREVIATIONS

BNL   Brookhaven National Laboratory

C-A   Collider – Accelerator Department

CD	Critical Decision
DOE	Department of Energy
ES&H	Environment, Safety and Health
ESH&Q	Environment, Safety, Health and Quality
ISMS	Integrated Safety Management System
L2	Level 2
M&TE	Measuring and Test Equipment
PC	Project Coordinator
PEP	Project Execution Plan
PHENIX	Pioneering High-Energy Nuclear Interacting Experiment
QA	Quality Assurance
QAC	Quality Assurance Coordinator
QAP	Quality Assurance Plan
QAR	Quality Assurance Representative
QMS	Quality Management System
RHIC	Relativistic Heavy Ion Collider
SBMS	Standards-Based Management System
WBS	Work Breakdown Structure

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1   INTRODUCTION

The sPHENIX Project is a project to design and upgrade the Pioneering High-Energy Nuclear Interacting Experiment (PHENIX) detector at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL). This upgrade brings exciting new capability to the RHIC program by opening new and important channels for experimental investigation and utilizing fully the luminosity of the recently upgraded RHIC facility. It enables a compelling jet physics program that will address fundamental questions about

the nature of the strongly coupled quark-gluon plasma discovered experimentally at RHIC to be a perfect fluid. The project is funded by the U.S. Department of Energy (DOE), RIKEN and other organizations.

The sPHENIX Project (hereafter, sPHENIX) will adopt, in its entirety, the BNL *Quality Assurance Program*. The *Quality Assurance Program* describes how the various BNL management system processes and functions provide a sound approach that conforms to the basic requirements defined in DOE Order 414.1D, *Quality Assurance*. These requirements include:

- Program
- Personnel training and qualification
- Quality improvement
- Documents and records
- Work processes
- Design
- Procurement
- Inspection and acceptance testing
- Management assessment
- Independent assessment

1.1 Purpose

The purpose of this Quality Assurance Plan (QAP) is to establish the Quality Assurance (QA) requirements for sPHENIX and describe how the requirements will be met, using a graded approach. This QAP has been developed to meet the criteria of DOE Order 414.1D, *Quality Assurance* and integrates quality requirements from BNL's Quality Assurance Program. This plan seeks to unify the project's QA activities, which are spread across multiple laboratories and universities, and is implemented via documented processes that address specific quality requirements.

1.2 Scope

This QAP provides requirements applicable to sPHENIX, encompassing all activities, including but not limited to design, fabrication, testing, integration and installation at BNL. Specific QA procedures will be developed, as necessary, for particular component or system QA. Institutional collaborators will be responsible for design, development, and component fabrication via Memoranda of Understanding (MOUs) and Statements of Work (SOWs) with BNL/sPHENIX. The collaborators' QA procedures will be

implemented in conjunction with that work, and must comply with the requirements in this Plan.

1.3 Approach

All BNL organizations use a management approach called the Standards-Based Management System (SBMS), whereby all functions of the Laboratory are defined within a finite set of fully integrated Management Systems, including a Quality Management System (QMS).

The QMS is chartered to deliver and maintain a Quality Assurance Program Description, which describes how various management system processes and functions provide for a Laboratory management approach that conforms to the basic requirements defined in the DOE Order 414.1D, *Quality Assurance*.

sPHENIX will be the responsible organization for implementing the QMS requirements for all project activities through completion of integration and installation.

A crosswalk matrix of the ten criteria in DOE Order 414.1D and BNL Implementation is provided as Attachment 1.

Existing PHENIX and Collider-Accelerator Department (C-A) procedures will be used, as appropriate and necessary, to supplement the QMS.

Additional QA procedures will be developed, as necessary, for a particular component or system.

Many institutions are responsible for carrying out various aspects of the project. Their own QA procedures will be implemented for their particular scope of work and must comply with the requirements in this plan.

Assessments, including periodic project reviews, will be conducted to ensure QA compliance.

1.4 Graded Approach

This QAP embodies the concept of graded approach; that is, selecting and applying an appropriate level of analysis and controls to work activities, equipment, and items commensurate with the potential for environmental, safety, health, radiological, or programmatic impact.

A graded approach is a process for determining that the appropriate level of analysis, management controls, documentation, and necessary actions are commensurate with an item's or activity's potential to

- Create an environment, safety, security, and health, or radiological hazard;

- Incur a monetary loss due to damage or repair/rework/scrap costs;

- Impact the lifecycle and/or reduce the availability of a facility or equipment;

- Adversely affect the project's objective or degrade data quality;

- Unfavorably impact the programmatic mission of BNL or the public's perception of BNL/DOE mission.

The graded approach does not allow the sPHENIX project's internal or external requirements to be ignored or waived, but does allow the degree of controls, verification, and documentation to vary in meeting requirements based on the risk level.

This methodology is described in the BNL SBMS *Graded Approach for Requirements* Subject Area and was developed to facilitate the application of the graded approach.

1.5 Definitions

The following is a list of definitions for terminology used in this plan:

Configuration Management - The technical and administrative direction and surveillance actions taken to identify and document the functional and physical characteristics of a configuration item; to control changes to a configuration item and its characteristics; and to record and report change processing and implementation status.

Environment, Safety and Health (ES&H) - An all-inclusive term that encompasses protection of the public, workers, and the environment.

Independent Assessment - An assessment conducted by individuals within the organization or company but independent from the work or process being evaluated, or by individuals from an external organization.

Item - An all-inclusive term used in place of appurtenance, assembly, component, equipment, material, module, part, structure, product, software, subassembly, subsystem, system, unit, or support systems.

Management Assessment - A periodic introspective self-analysis, conducted by management, to evaluate management systems, processes, and programs ensuring the project team's work is properly focused on achieving desired results.

Measuring and Test Equipment (M&TE) - Devices or systems used to calibrate, measure, gauge, test, inspect, or control in order to acquire research and development, test, or operational data to determine compliance with design, specifications, or other technical requirements

Quality (Q) - The condition achieved when an item, service, or process meets or exceeds the user's requirements and expectations.

Quality Assurance (QA) - All actions and controls necessary to provide confidence that quality is achieved.

QA Plan (QAP) - The document describing the QA program (requirements) that the project will implement. The QAP typically includes a matrix of the QA requirements and the associated implementing procedures used by the project.

QA Program - The overall program or management system established to assign responsibilities and authorities, define policies and requirements, and provide for the performance and assessment of work.

Quality Assurance Representative (QAR) – the individual who is to perform quality assurance functions.

2   QUALITY ASSURANCE PROGRAM

The sPHENIX project is carried out by BNL, as described in the sPHENIX Project Execution Plan (PEP), and managed by the sPHENIX Project Management. The project has a supporting structure organized according to the Work Breakdown Structure (WBS) assigned to the project and listed in the main body of the PEP. The Project Coordinator maintains an organization chart that provides the tier structure for the flow-down of QA requirements with this QAP as the top tier. General descriptions of the primary functions for the groups are also found in the PEP. L2 Managers set QA goals and objectives pertaining to their work environments and periodically assess progress toward them.

2.1   Responsibility for Managing

The sPHENIX Project Coordinator (PC) manages the project and is responsible for achieving performance goals.
The sPHENIX Quality Assurance Coordinator (QAC) is responsible for ensuring that a quality system is established, implemented, and maintained in accordance with QA standards and requirements. The QAC reports to the BNL Physics Department Chair and provides oversight and support to the project participants to ensure a consistent quality program.

The sPHENIX L2 Managers are responsible for implementing the QAP within their subsystem and reporting their QA issues to the sPHENIX Project Coordinator. The L2 Managers may also designate QA representatives within their organization; whether the L2 Manager retains responsibility or has a designee, they are hereafter referred to as the Quality Assurance Representative (QAR).

2.2 Level of Authority and Interface

The PEP and this QAP together define the responsibility, authority, and interrelation of personnel who manage, perform, and verify work that affects quality. This QAP defines the roles and responsibilities of management and the working levels of the project.

All employees, collaborators, contractors, and subcontractors are responsible for the quality of the work that they do and for using the guidance and assistance that is available. Each has the authority to stop work and report adverse conditions that affect the quality of the project deliverables to their respective QAR. Personnel responsible for the project components or systems work with their QAR to determine and document their acceptance criteria. Management at each level is responsible for evaluation of quality through management assessments; however, independent assessments may be requested by project management.

The QAC is responsible for ensuring the development, implementation, assessment, and improvement of the QA program. The QAC is also responsible for periodically reporting on the performance of the quality system to the Project Coordinator for his/her review and as a basis for improvement of the quality system.

2.3 Quality Assurance Organization

The sPHENIX QA organization is to be comprised of representatives from across the Project Team to perform QA functions, based on need, in accordance with the graded approach described above. L2 Managers are responsible for appointing QARs that possess qualifications required to perform these functions.

3 PERSONNEL TRAINING AND QUALIFICATION

sPHENIX managers are responsible for ensuring that their staff members are trained and qualified to perform their assigned work effectively and safely.

Before personnel are allowed to work independently, management is responsible for ensuring personnel have the necessary experience, knowledge, skills, and abilities. Personnel qualifications are based on factors such as:

- Previous experience, education, and training

- Performance demonstrations or tests to verify previously acquired skills

- Completion of training or qualification programs

- On-the-job training.

The training process for employees, guests, and contractors is described in the BNL SBMS *Training and Qualification* Subject Area. Personnel will each have a Job Training Assessment (JTA) that identifies required training for their position. The Brookhaven Training Management System (BTMS) will be used to track the JTA status of each worker.

All project participants are responsible for ensuring that their training and qualification requirements are fulfilled, including continuing training to maintain proficiency and qualifications, where applicable.

4 QUALITY IMPROVEMENT

Processes to detect and prevent quality problems will be established and implemented, including:

- Design reviews

- Baseline change reviews

- Inspection and testing
- Work planning
- Assessments

Item characteristics, process implementation, and other quality-related information will be reviewed and the data analyzed to identify items, services, and processes needing improvement.

Problems identified by assessment, analysis, test, inspection, and other means will be controlled and corrected using the graded approach described in this plan. The sPHENIX database will be the primary tool used to track conformity of the project items. Where appropriate, the cause(s) of the problem will be identified and corrected to prevent recurrence.

Occurrence reporting will be executed as required by DOE for certain defined events or conditions.

To promote continual improvement, sPHENIX will participate in the BNL Lessons Learned Program. This program provides a systematic approach to identify and analyze relevant information for both good and adverse work practices that can influence successful project execution. Sources of lessons learned include the DOE Lessons Learned List Server, the BNL Lessons Learned Database, and sPHENIX staff who participate in peer reviews of other DOE projects. Lessons learned will be gathered throughout the project lifecycle. As part of the CD-4 closeout phase, a lessons learned report will be submitted.

All project participants are encouraged to identify problems or potential quality improvements and may do so without fear of reprisal or recrimination.

5   DOCUMENTS AND RECORDS

Documents will be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish designs that are adequate to procure, fabricate, review, install, locate, repair, and maintain systems that comprise the project. sPHENIX manages all specifications, technical notes, database records, drawings, test and/or calibration records, and other controlled documents under a document control system. BNL SBMS *Document Control* Subject Area states the requirements and offers guidance for developing, reviewing, approving, controlling, and maintaining documents. The project managers will use the graded approach described in this plan to determine work in their scope that requires the preparation of controlled documents.

Records are prepared and maintained to provide evidence that activities have been performed or results have been achieved. Guidelines will be followed for storing and maintaining records for the project in accordance with BNL SBMS *Records Management* Subject Area. Project management, team, and task leaders are responsible for identifying the records to be preserved. In addition to the technical, cost, and schedule baseline and all changes to it, records must be preserved that show evidence or proof that a decision was made or an action taken and the justification for the decision or action.

The QAC and QAR are responsible for bringing to the attention of project management any deficiencies in documentation that compromise the performance and reliability goals for the project. Deficiencies in documentation should be identified early in the project, so remedial efforts do not impact the project schedule.

6   WORK PROCESSES

sPHENIX workers are responsible for the quality of their work and L2 Managers are required to identify the resources and support systems to enable staff to do their work. All work will be performed using methods that promote successful completion of tasks, conformance to project requirements, and compliance with Environment, Safety, Health and Quality (ESH&Q) rules. Work processes consist of a series of actions planned and carried out by qualified personnel using approved procedures, instructions, and equipment under administrative, technical, and environmental controls to achieve a result.

Work processes will be managed according to the following criteria:

- **Resources** - Managers and group leaders throughout sPHENIX shall ensure that resources and support systems at the various institutions are sufficient to enable their staff to do their work using methods that promote successful completion of

tasks, conformance to the project requirements, and compliance with ESH&Q rules.

- **Graded Approach** - The project management (managers, group leaders, and task leaders) shall use the graded approach described in this plan to determine the appropriate work controls based on the type of work being done. QARs may assist in these determinations.

- **ES&H** - The project management shall ensure that management of ES&H functions and activities is an integral and visible part of the work planning and execution processes, including use of Integrated Safety Management System (ISMS) guiding principles and worker participation in work planning.

- **Training** - The project management shall ensure that employees, collaborators, and subcontractors are properly trained in and knowledgeable of the procedures, instructions, drawings, specifications, and other related administrative and technical documents that control their work. Where processes require specially qualified personnel, the performing personnel shall be appropriately trained and certified to the qualified process/procedure before performing those processes.

- **Work Planning** - Work on sPHENIX shall be performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means.

  To assure safe and effective accomplishment of the tasks required, work will be systematically planned and executed in accordance with PHENIX procedure PP-2.5.6.1-02, *PHENIX Work Planning,* which describes the nature of work planning at PHENIX and the system by which work is planned at PHENIX.

- **Acceptance Planning** - Systems or components that are determined to have high ES&H or programmatic impact shall have plans for acceptance based on the creation and completion of inspection and test records.

- **Conduct of Work** - Work shall be performed safely, in a manner that ensures adequate protection for employees, the public, and the environment, and management shall be accountable for the safe performance of work. Employees and management shall exercise a degree of care commensurate with the work and the associated hazards. Details are provided in the sPHENIX Safety and Hazard Analysis.

- **Item Control and Protection** - Items, including consumables, shall be identified and controlled to ensure their proper use and prevent the use of incorrect, unaccepted, or unidentified items. The project will define a system of controls to ensure that items are handled, stored, shipped, cleaned, and

preserved to prevent them from deteriorating, being damaged, or becoming lost. These controls will be established according to instructions, specifications, drawings, and technical manuals for items that are sensitive, have a high cost, or have been identified as having a significant impact on the environment or schedule.

- **Calibration** - Equipment used for process monitoring or data collection shall be identified, controlled, calibrated, and maintained. Calibration shall be controlled by a system or systems making appropriate use of qualified calibration service providers, equipment calibration-status tracking database(s), and approved methods for adding equipment items to the controlled system.

7   DESIGN

The sPHENIX design process provides appropriate control of design inputs and design outputs. The primary design inputs are the sPHENIX programmatic and scientific/ engineering requirements documentation. The primary design outputs are the programmatic (cost, schedule, management reports, etc.) and scientific/engineering documents (specifications, drawings, engineering reports, etc.). The basis of the design process requires sound engineering judgment and practices, adherence to scientific principles, and use of applicable orders, codes and standards, including ESH&Q concerns.

7.1   Design Process

The scope of design work for any given scientific/engineering work group is defined by the sPHENIX requirements. From the requirements, preliminary design of the project will begin by breaking the work into sets of engineering drawings, specifications, and reports. This is the design output.

Throughout the design process, engineers and designers work with the project QARs to determine QA inspection criteria of fabricated parts and installations. Close coordination is also made with the project scientists to assure the engineering satisfies the scientific requirements of the experiment. Configuration management, through use of engineering drawing management software, will be implemented to control designs. Final design work sets the final QA parameters for the parts, assemblies, and installations. Design during production is confined, making changes necessary to facilitate production, drawing error correction, material substitutions, and the like.

7.2   Design Verification and Validation

The design will be verified and validated to an extent commensurate with its importance to safety, complexity of design, degree of standardization, state of the art, and similarity

to proven design approaches. Acceptable verification methods include but are not limited to any one or combination of (1) design reviews, (2) alternate calculations, and (3) qualification testing and comparison of the new design with a similar proven design, if available. Verification work will be completed before approval and implementation of the design.

Design reviews are conducted by the sPHENIX Technical Committee chartered by the Project Coordinator prior to final design acceptance and implementation.

Design reviews shall verify/validate the following at the appropriate milestone:

- Technical adequacy of the design
- Specifications
- Adherence to requirements
- Interface compatibility
- Work instructions
- Review of test results and other applicable reports
- Design calculations and drawings
- Reliability and useful life considerations
- Calibration program for measurement and test data.

Where the design method involves the use of computer software to make design calculations or dynamic models of the structure, system, or component's functionality, the software must have been demonstrated to produce validated results. The demonstration needs to be documented in a formal report of validation that is maintained in records that are accessible for inspection. However, exemptions may be made for commercially available software that is widely used and for codes with an extensive history of refinement and use by multiple institutions, if the validation is evidently unlikely to reveal a problem and is difficult and/or expensive to complete.

Critical computer codes for controlling the operation of the sPHENIX detector will also be subjected to review.

Design validation will be performed to ensure that the design output conforms to defined project needs and/or requirements. Design validation follows successful design verification. Designs will be validated, preferably before procurement, manufacture, or construction, but no later than acceptance and use of the item, in order to ensure that the design:

- meets the design-input requirements;
- contains or make reference to acceptance criteria; and
- identifies those design characteristics that are crucial to the safe and proper functioning of the equipment or system.

Each independent inspection, test, or review will feed the evaluation process, which is a comparison of results with acceptance criteria to determine acceptance or rejection, or the need for corrective action. In some cases, the outcome may be to seek adjustments to requirements.

The formality of reporting will escalate as the significance of the review or test increases. Higher levels of management must be aware of and participate in the correction of the most significant problems. Required design analyses and calculations will be performed and documented. The resulting documentation should include the assumptions, actual calculations, design inputs, references, and units in sufficient detail such that a technically qualified person could review and understand the analyses and verify the results.

Design output documents will be reviewed and approved before release.

7.3   Configuration Management

Configuration management, through use of engineering drawing management software, will be implemented to control designs. It is accomplished throughout the project life-cycle through use of fundamental engineering documentation principles such as design requirements change control, drawing and specification change control, and revision control.

At the BNL level, the BNL SBMS *Engineering Design* Subject Area describes the configuration management requirements on a somewhat generic level.

On a closer level of RHIC, configuration management is governed by the Collider Accelerator Department (C-A) Operating Procedures Manual (OPM). The C-A OPM is designed to meet the more generic requirements of the SBMS with C-A specific procedures. At this level C-A OPM provides for guidance for implementing configuration management for all C-A drawings and specifications with C-A OPM 13.6.2, *Configuration Management.* This OPM describes the process by which changes to the configuration of C-A equipment and facilities are documented to assure that a reliable and consistent system reflects the current configuration of the parts, assemblies and/or complete articles which comprise the facilities and equipment managed by C-A.

At the PHENIX level, all SBMS requirements flow down as do the requirements of the C-A OPM for equipment and facilities which comprise the PHENIX experiment. Such equipment is divided into 2 categories: a) equipment and facilities managed by C-A engineering, and b) equipment and facilities managed by PHENIX engineering and/or PHENIX collaborators.

PHENIX procedure PP-2.5.6.1-03, *PHENIX Configuration Management,* describes the demarcations between the 2 categories and the configuration management requirements for all such equipment and facilities. It defines a process for the review of technical changes to PHENIX drawings and specifications, including drawings and specifications generated by C-A engineering, by PHENIX engineering or PHENIX external collaborators' engineering. This process supplements the BNL SBMS *Engineering Design* Subject Area.

Revised drawings and specifications are to be created, maintained and controlled as described in PHENIX procedure PP-2.5.6.1-04, *PHENIX Engineering Documentation Control*.

L2 Managers may use site-specific formalized processes for generating, maintaining, and reviewing engineering changes, providing that they meet established quality and configuration management requirements, are in accordance with contractual requirements, and meet the design requirements.

8   PROCUREMENT

Procurement controls will be implemented to ensure that purchased items and services meet project needs and comply with applicable quality requirements.

sPHENIX personnel requesting procurement of items and services are responsible for providing technical, ESH&Q, and other specifications that adequately describe the item or service being procured so that the supplier can understand what is desired and what will be accepted. Development of these specifications may be achieved through the involvement of QARs and through established review and approval systems. The following factors should be considered:

- Technical performance requirements

- Compliance to appropriate industry standards

- Laws and regulations

- Acceptance criteria, including requirements for receiving inspection and/or source inspection

- Vendor qualifications and certifications

- Acceptance sampling

The BNL SBMS *Purchase Requisition Review for Quality-related Requirements* Subject Area provides a methodology for selecting and applying quality-related requirements to be imposed upon a supplier. Quality requirements that become part of the

procurement/contract document are selected based upon the graded approach. The graded approach is used to ensure that only those requirements necessary are selected, i.e., requirements that may incur a cost are selected based on the mitigation of programmatic and ES&H concerns.

L2 Managers will use established processes to ensure that procured items and services meet the established requirements, perform as specified, and meet the expectations of the end user. The need for inspection and acceptance testing is determined during project or activity planning, based on the graded approach. In addition, the processes will ensure that suppliers are evaluated and selected on the basis of specified criteria. The stringency of the procurement requirements is commensurate with the ESH&Q risk of the purchased items or services to the project or activity. For critical items, these requirements may include but are not limited to establishing supplier milestones, inspections of vendor progress during the manufacturing phase, production of prototypes, and delivery of pre-production units for inspection and testing.

Unacceptable items or services are documented. Records of supplier performance (e.g., inspection and test records and contract-required submittals) will be maintained.

Counterfeit and/or suspect parts are prohibited. Inspections will be used to detect violations. The BNL SBMS *Suspect/Counterfeit Items* Subject Area provides a process for conducting inspections of acquired items, items in storage/inventories, and installed components/assemblies to look for suspect/counterfeit items.

9   INSPECTION AND ACCEPTANCE TESTING

Inspection and testing of specified items, services, and processes will be conducted using established acceptance and performance criteria, and equipment used for inspection and tests will be calibrated and maintained.

The need for inspection and acceptance testing is determined during project or activity planning based on the graded approach. Nonconforming items will be identified and controlled to prevent their unintended use.

The BNL SBMS *Inspection and Acceptance* Subject Area provides steps for inspection, including testing, and acceptance of internal and external purchased items/services; conducting in-process, final, and source inspections; and determining criteria for inspection and acceptance.

Designated inspection/tests will be performed using equipment that is calibrated and maintained. The calibration status will be readily discernible and associated calibration procedures, documentation, and records shall be prepared and maintained. Calibrated equipment will be properly protected, handled, and maintained to preclude damage that could invalidate its accuracy. Measuring and test equipment (MT&E) that is found out of calibration will be identified and its impact evaluated.

When required, acceptance and performance criteria are developed and documented for key, complex, or critical inspection/test activities. If an item is nonconforming, it is identified as such to avoid its inadvertent use. These processes also specify how inspection and test status (i.e., accept, reject) will be indicated either on the item itself or on documentation traceable to the item.

All inspection and acceptance testing results will be maintained as project records in accordance with this QAP, Section 5, *Documents and Records*.

10 MANAGEMENT ASSESSMENT

sPHENIX management, at all levels, will regularly assess their management processes, and identify and correct problems that hinder the project from achieving its objectives. The management assessment process shall periodically include an evaluation of the project deliverables and processes to determine whether the project's missions are being fulfilled. The results of management assessments, which focus on means to improving the quality of work performed, will be reported to the appropriate responsible line or project management level.

When performance does not meet established standards, management shall, with the assistance of others with appropriate expertise, determine the cause and initiate corrective action. QARs may assist, lead, or facilitate cause investigations.

11 INDEPENDENT ASSESSMENT

sPHENIX management will plan and conduct independent assessments to assist L2 Managers in identifying opportunities for quality/performance-based improvement and to ensure compliance with specified requirements. Independent assessments of the project can be requested by sPHENIX management. Independent assessments typically focus on quality or ES&H management systems and processes, self-assessment programs, or other organizational functions identified by management. The project utilizes a formal process for assigning responsibility for responding to findings and recommendations from independent assessments and tracking these issues to closure.

Person(s) conducting independent assessments shall be technically qualified and knowledgeable in the areas assessed. The assessment team may include other subject matter experts to evaluate the adequacy and effectiveness of activities if they are not responsible for the work being assessed.

An independent committee, known as the Integrated Project Team (IPT), has been chartered to advise BNL and sPHENIX management. The roles of the standing committee are described in the sPHENIX PEP.

DOE also performs external assessments that provide an objective view of performance and as a result, contribute to the independent assessment process. Since such assessments are not under the control of sPHENIX, they are not necessarily considered as being part of the independent assessment criterion. However, sPHENIX management considers external assessment results and schedules in determining the scope of its planned management and independent assessments.

12 REFERENCES

12.1 DOE

[1] DOE O 414.1D, Quality Assurance, *(https://www.directives.doe.gov/directives/0414.1-BOrder-d/view)*

[2] DOE G 414.1-1B, Management Assessment and Independent Assessment Guide, *(https://www.directives.doe.gov/directives/0414.1-EGuide-1b/view)*

[3] DOE G 414.1-2B, Quality Assurance Program Guide for use with 10 CFR 830 Subpart A, Quality Assurance Requirements, and DOE O 414.1D, Quality Assuranc*e (https://www.directives.doe.gov/directives/0414.1-EGuide-2Badmchg1/view)*

[4] DOE G 413.3-11, Project Management Lessons Learned, (https://www.directives.doe.gov/directives/0413.3-EGuide-11/view*)*

12.2 Other Documents

[5] ISO 9001:2008, *Quality Management Systems-Requirements*,

[6] BNL Quality Assurance Program *(https://sbms.bnl.gov/SBMSearch/ProgDesc/QAP/QAP_PD.cfm)*

ATTACHMENT 1

Crosswalk Matrix - DOE Order 414.1D and BNL Implementation

DOE QA Requirements 414.1D and 10 CFR 830.120	BNL Implementation
Quality Assurance Program Development and Implementation. A contractor must assign and identify a senior management position responsible for the development, implementation, assessment, and improvement of a QAP that does the following: (1) Implements quality assurance criteria using a graded approach and describing how the criteria and graded approach are applied.	• Quality Management Management System Description • Quality Assurance Program Description • Suspect/Counterfeit Items Program Description • Graded Approach for Requirements Subject Area
(2) Uses voluntarily national or international consensus standard where practicable and consistent with contractual or regulatory requirements and identifies the standard used. Appropriate standards include the following.	• ASME NQA-1-2004, *Quality Assurance Requirements for Nuclear Facility Applications* (for nuclear-related activities); • ANSI/ASQ Z 1.13, *Quality Guidelines for Research,* 1999
(3) Applies additional standards, where practicable and consistent with contractual or regulatory requirements as Necessary to address unique/specific work activities (e.g., development and use of safety software or establishing the competence of a testing and calibration laboratory).	• Software Quality Assurance Subject Area • ASME NQA-1-2004 • ISO-14001 • OHSAS-18001 Program Subject Area • Electrical Safety Subject Area • NFPA 70E • ANSI • ASME

DOE QA Requirements 414.1D and 10 CFR 830.120	BNL Implementation

(4) Integrates, where practicable and consistent with contract or regulatory requirements, quality management system requirements as defined in this CRD, the S/CI prevention process (Paragraph 4) and Safety Software Quality Requirements (Paragraph 5) with other quality or management system requirements in DOE directives and external requirements, including as applicable –
 	
   a) DOE P 450.4, Safety Management System Policy, dated 10-15-96.
   b) DOE P 450.5, Line Environment, Safety and Health Oversight, dated 06-26-97.
   c) NNSA Quality Management Policy, QC-1, (quality management system for the nuclear weapons complex and weapons-related activities).
   d) DOE/RW-0333P, DOE Office of Civilian Radioactive Waste Management, Quality Assurance Requirements and Description.
   e) DOE/CBFO-94-1012, DOE Carlsbad Field Office, Quality Assurance Program Description, (for the Waste Isolation Pilot Plant and related activities).
	• Quality Management Management System Description
	• Quality Assurance Program Description
	• Suspect/Counterfeit Items Program Description
	• Integrated Safety Management System Program Description
	• Software Quality Assurance Subject Area
	• Event/Issues Management Subject Area

DOE QA Requirements 414.1D and 10 CFR 830.120	BNL Implementation
Management/Criterion 1 – Program (a) Establish an organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing work. (b) Establish management processes, including planning, scheduling, and providing resources for work.	• Quality Management Management System Description • Standards-Based Management System Management System Description • BNL Organization Chart • BNL Policies, Standards of Performance, Management Systems, and Subject Areas • Graded Approach for Requirements Subject Area • Training and Qualifications Management System Description • Training and Qualifications Subject Area • Human Resources Management System Description • Roles, Responsibilities, Accountabilities, and Authorities (R2A2) Subject Area • Integrated Assessment Program Management System Description • Organizational Self-assessment Subject Area • Integrated Planning Management System Description • Work Planning and Control Management System Description • Work Planning and Control for Experiments and Operations Subject Area • Financial Management Management System Description • Budget Manual • Science and Technology Program Management Management System Description • Environmental Management System Management System Description
Criterion 2 – Management/Personnel Training and Qualification. (a) Train and qualify personnel to be capable of performing their assigned work. (b) Provide continuing training to personnel to maintain their job proficiency.	• Training and Qualifications Management System Description • Training and Qualifications Subject Area • Work Planning and Control Management System Description • Work Planning and Control for Experiments and Operations Subject Area • Worker Safety and Health Management System Description • Construction Safety Subject Area • Fitness for Duty Subject Area • Human Resources Management System Description

DOE QA Requirements 414.1D and 10 CFR 830.120	BNL Implementation
Management /Criterion 3 – Quality Improvement (a) Establish and implement processes to detect and prevent quality problems. (b) Identify, control, and correct items, services, and processes that do not meet established requirements. (c) Identify the causes of problems, and include prevention of recurrence as a part of corrective action planning. (d) Review item characteristics, process implementation, and other quality-related information to identify items, services, and processes needing improvement.	• Integrated Assessment Program Management System Description • Integrated Assessment Subject Area • Health, Safety and Security Regulatory Compliance Validation and Noncompliance Reporting Program Description • Environmental Management System Management System Description • Environmental Assessments Subject Area • Work Planning and Control Management System Description • Work Planning and Control for Experiments and Operations Subject Area • Radiological Control Management System Description • Radiological Stop Work Subject Area • Quality Management Management System Description • Inspections and Acceptance Subject Area • Lessons Learned Subject Area • Event/Issues Management Subject Area • Occurrence Reporting and Processing System (ORPS) Subject Area • Event/Issues Management Subject Area • Assessment Tracking System (ATS) • Communications, Government, Community Relations and Education Management System Description • Human Resources Management System Description • Worker Safety and Health Management System Description • Continual Improvement of Repetitive Business Processes Program Description
Management/Criterion 4 – Documents and Records. (a) Prepare, review, approve, issue, use, and revise documents to prescribe processes, specify requirements, or establish design. (b) Specify, prepare, review, approve, and maintain records.	• Quality Management Management System Description • Document Control Subject Area • Standards-Based Management System (SBMS) Management System Description • SBMS Documents Subject Area • Science and Technology Program Management Management System Description • Publishing Scientific and Technical Information (STI) Subject Area • Records Management Management System Description • Records Management Subject Area

DOE QA Requirements 414.1D and 10 CFR 830.120	BNL Implementation
Performance/Criterion 5 – Work Processes. (a) Perform work consistent with technical standards, administrative controls, and hazard controls adopted to meet regulatory or contract requirements using approved instructions, procedures, etc. (b) Identify and control items to ensure their proper use. (c) Maintain items to prevent their damage, loss, or deterioration. (d) Calibrate and maintain equipment used for process monitoring or data collection.	• Integrated Assessment Program Management System Description • Integrated Safety Management System Program Description • Work Planning and Control Management System Description • Work Planning and Control for Experiments and Operations Subject Area • Worker Safety and Health Management System Description • Electrical Safety Subject Area • Real Property Asset Management Management System Description • Maintenance Management Subject Area • Facility Safety Management System Description • Radiological Control Management System Description • Acquisition Management System Management System Description • Materials Requiring Special Handling (Including Age Sensitive Material) SA • Environmental Management System Management System Description • Radiological Control Manual Program Description • Quality Management Management System Description • Graded Approach for Requirements Subject Area • Calibration Subject Area • Inspections and Acceptance Subject Area • Standards-Based Management System Management System Description • SBMS Documents Subject Area • Hazard Analysis Subject Area • Readiness Evaluations Subject Area **The following are examples of additional subject areas that implement this Criterion:** **Environmental** • Drinking Water Subject Area • Environmental Assessments and ESH Management Review Subject Area • Environmental Monitoring Subject Area • EM-SOP-309, "Groundwater Protection Contingency Plan—Response to Unexpected Monitoring Results" • Environmental Aspects and Impacts Subject Area • Industrial Waste Subject Area • Liquid Effluents Subject Area • Mixed Waste Management Subject Area • National Environmental Policy Act (NEPA) and Cultural Resources Evaluations Subject Area • Non-Radioactive Airborne Emissions Subject Area • PCB Management Subject Area • Pollution Prevention and Waste Minimization Subject Area • Process Assessment Subject Area • Radioactive Airborne Emissions Subject Area • Regulated Medical Waste Management Subject Area • Spill Response Subject Area • Storage and Transfer of Hazardous and Nonhazardous Materials Subject Area • Underground Injection Control Subject Area • Hazardous Waste Management Subject Area • Radioactive Waste Management Subject Area

DOE QA Requirements 414.1D and 10 CFR 830.120	BNL Implementation
Performance/Criterion 6 – Design (a) Design items and processes using sound engineering/ scientific principles and appropriate standards. (b) Incorporate applicable requirements and design bases in design work and design changes. (c) Identify and control design interfaces. (d) Verify/validate the adequacy of design products using individuals or groups other than those who performed the work. (e) Verify/validate work before approval and implementation of the design.	• Real Property Asset Management Management System Description • Work Planning and Control Management System Description • Worker Safety and Health Management System Description • Construction Safety Subject Area • Engineering Design Subject Area • Facility Safety Management System Description • Accelerator Safety Subject Area • Nuclear/Criticality Safety Subject Area • Readiness Evaluations Subject Area • Work Planning and Control for Experiments and Operations Subject Area • Information Resource Management Management System Description • Software Quality Assurance Subject Area • Configuration Management Program Description
Performance/Criterion 7 – Procurement. (a) Procure items and services that meet established requirements and perform as specified. (b) Evaluate and select prospective suppliers on the basis of specified criteria. (c) Establish and implement processes to ensure that approved suppliers continue to provide acceptable items and services.	• Acquisition Management Management System Description • Purchase Requisition Review for Quality-related Requirements Subject Area • Supplier Pre-Award Evaluation Subject Area • Credit Cards, Procurement Subject Area • Information Resource Management Management System Description • Radiological Control Manual Program Description • Procurement Operations Manual • Radiological Stop Work Subject Area • Procurement of and Approval to Use Radioactive Materials (Radiological Control Procedure) • Quality Management Management System Description • Suspect/Counterfeit Items Subject Area • Graded Approach for Requirements Subject Area • Inspections and Acceptance Subject Area • POM Chapter III - Fundamental Procurement Processes
Performance/Criterion 8 – Inspection and Acceptance Testing (a) Inspect and test specified items, services, and processes using established acceptance and performance criteria. (b) Calibrate and maintain equipment used for inspections and tests.	• Acquisition Management Management System Description • Quality Management Management System Description • Inspections and Acceptance Subject Area • Suspect/Counterfeit Items Subject Area • Calibration Subject Area • Event/Issues Management Subject Area

DOE QA Requirements 414.1D and 10 CFR 830.120	BNL Implementation
Assessment/Criterion 9 – Management Assessment. (a) Ensure that managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives.	• Integrated Assessment Program Management System Description • Integrated Assessment Subject Area • Worker Safety and Health Management System Description • Environment, Safety, Health and Quality (Tier 1) Inspections Subject Area • Environmental Management System Management System Description • Environmental Assessments Subject Area • Process Assessment Subject Area • OHSAS 18001 Program Subject Area • Quality Management Management System Description • Event/Issues Management Subject Area • Assessment Tracking System (ATS) • Assessment Support Center
Assessment/Criterion 10 – Independent Assessment. (a) Plan and conduct independent assessments to measure item and service quality and the adequacy of work performance and to promote improvement. (b) Establish sufficient authority and freedom from line management for independent assessment teams.	• Integrated Assessment Program Management System Description •Internal Audit •Independent Oversight •Peer Review •Corporate Oversight • Independent Certifying Bodies for registration (e.g., ISO, OHSAS, DOELAP) • Quality Management Management System Description • Event/Issues Management Subject Area • Assessment Support Center